PATENT ABSTRACTS OF JAPAN

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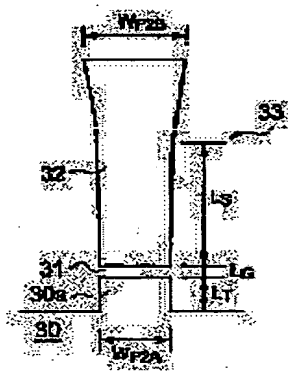
(54) THIN FILM MAGNETIC HEAD AND ITS PRODUCTION

(57)Abstract:
PROBLEM TO BE SOLVED: To make a track width narrower and to improve an overwrite characteristic by allowing an upper magnetic pole to have an equal width from the first side of a recording gap side to at least a position where is separated by a prescribed distance from the first side and allowing the second end of a side opposite to the recording gap to have a width wider than that of a first end.
SOLUTION: The lower end of an upper magnetic pole 32 is opposed to the upper end of the projecting part 30a of a lower magnetic pole 30 with a recording gap 31 and the projecting part 30a has a width WP2A and the upper magnetic pole 32 also has a width equal to this width WP2A from the lower end of the pole to a position being a prescribed distance Ls and the width of the pole 32 becomes gradually larger in curved line shapes from this position and becomes a width WP2B at the upper end of the pole. When the length Ls of the equal width part is set to be Ls≥1.0 μm, since the effective track width of a magnetic head is not broad and the width of the inlet side of a magnetic flux becomes wider and the width of the outlet side of the flux becomes narrower, a satisfactory overwrite characteristic can be maintained and at the same time, the narrowing of the track width is made possible.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] It is the thin film magnetic head characterized by being the thin film magnetic head equipped with the recording head section containing the lower magnetic pole and up magnetic pole which counter mutually through a record gap, and for said up magnetic pole having width of face equal to predetermined distance detached building ****** at least from the 1st edge by the side of said record gap, and having width of face with the 2nd edge of the opposite side of this record gap larger than the width of face of said 1st edge.
[Claim 2] The width of face of said up magnetic pole is the thin film magnetic head according to claim 1 characterized by changing almost continuously from said predetermined distance detached building ****** to said 2nd edge.
[Claim 3] The thin film magnetic head according to claim 1 or 2 to which the edge by the side of said record gap of said lower magnetic pole is characterized by having projected to convex in the part which counters said up magnetic pole, and this lobe having width of face equal to the width of face of said 1st edge.
[Claim 4] The thin film magnetic head according to claim 1 or 2 characterized by forming evenly the edge by the side of said record gap of said lower magnetic pole including the part which counters said up magnetic pole.
[Claim 5] The thin film magnetic head given in any 1 term of claims 1-4 characterized by said predetermined distance being 1 micrometer.
[Claim 6] The thin film magnetic head given in any 1 term of claims 1-5 characterized by carrying out laminating formation of the reproducing-head section equipped with the magneto-resistive effect component in one with said recording head section.
[Claim 7] It is the manufacture approach of the thin film magnetic head which forms an up magnetic pole while carrying out the laminating of the layer for record gaps and forming a coil on the layer for these record gaps, after carrying out the laminating of the layer for lower magnetic poles. The manufacture approach of the thin film magnetic head characterized by forming in the configuration which has width of face equal to predetermined distance detached building ****** at least for said up magnetic pole from the 1st edge by the side of said record gap, and has width of face with the 2nd edge of the opposite side of this record gap larger than the width of face of said 1st edge.
[Claim 8] The manufacture approach according to claim 7 characterized by forming said up magnetic pole so that the width of face may change almost continuously from said predetermined distance detached building ****** to said 2nd edge.
[Claim 9] The manufacture approach according to claim 7 or 8 characterized by setting said predetermined distance to 1 micrometer.
[Claim 10] The manufacture approach given in any 1 term of claims 7-9 characterized by controlling and forming the exposure conditions of a resist [in / for the configuration of said up magnetic pole / the frame galvanizing method].
[Claim 11] The manufacture approach according to claim 10 that said exposure conditions are characterized by being the focal location of exposure, or the numerical aperture of exposure optical system.
[Claim 12] The manufacture approach given in any 1 term of claims 7-11 characterized by carrying out dry etching of the layer for these lower magnetic poles by using this up magnetic pole as a mask so that the edge by the side of said record gap of said lower magnetic pole may have projected to convex in the part which counters said up magnetic pole and may serve as a configuration in which this lobe has width of face equal to the width of face of said 1st edge.
[Claim 13] The manufacture approach given in any 1 term of claims 7-12 characterized by forming this magneto-resistive effect component after carrying out the laminating of the layer for the 1st shielding and carrying out the laminating of the layer for magneto-resistive effect components through the layer for shielding gaps on the layer for this 1st shielding on a substrate front face, and subsequently to this magneto-resistive effect component top carrying out the laminating of the layer for said lower magnetic poles through the layer for shielding gaps.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the thin film magnetic head which has the inductive recording head section for performing magnetic recording to magnetic media, such as a hard disk and a floppy disk, and its manufacture approach.
[0002]
[Description of the Prior Art] The tip exposed to ABS (surfacing side) has countered mutually through a record gap, and the inductive recording head section mainly consists of two magnetic poles which touch mutually as York in a posterior part, and a coil currently wound around the perimeter in the York.
[0003] Drawing 1 and drawing 2 are the sectional views showing the outline structure seen from the ABS side of the magnetic pole in the conventional inductive recording head.
[0004] In drawing 1 , in 10, a lower magnetic pole and 11 show a record gap, and 12 shows the up magnetic pole, respectively. In this inductive recording head, it is formed so that the width of face WP 2 of the up magnetic pole 12 may become the same also in that opposite side also in a record gap side.
[0005] Since resistance produces the inductive recording head which has the up magnetic pole 12 of such a configuration in the inflow of the magnetic flux to a magnetic pole, an over-writing property will become comparatively low.
[0006] The inductive recording head equipped with the up magnetic pole of a configuration as shown in drawing 2 as structure of improving such un-arranging exists. In this drawing, in 20, a lower magnetic pole and 21 show a record gap, and 22 shows the up magnetic pole, respectively. WP2 of the up magnetic pole 22 is becoming large gradually toward a record gap side to that opposite side, and since the inflow side of magnetic flux becomes large by this, this head can raise an over-writing property.
[0007]
[Problem(s) to be Solved by the Invention] However, according to the conventional inductive recording head shown in drawing 2 , the problem that the effective width of recording track for record will spread inevitably arises. Since it is required that the width of recording track of the magnetic head should be made narrower especially in connection with the densification of magnetic recording in recent years, such effective truck broadening is a big problem.
[0008] Therefore, the purpose of this invention is to offer the thin film magnetic head which can attain both improvement in the formation of the ** width of recording track, and an over-writing property to coincidence, and its manufacture approach.
[0009]
[Means for Solving the Problem] According to this invention, it is the thin film magnetic head equipped with the recording head section containing the lower magnetic pole and up magnetic pole which counter mutually through a record gap, and the thin film magnetic head in which an up magnetic pole has width of face equal to predetermined distance detached building ****** at least from the 1st edge by the side of a record gap, and the 2nd edge of the opposite side of a record gap has width of face larger than the width of face of the 1st edge is offered.
[0010] Since the 2nd edge of the opposite side of a record gap serves as a configuration which has width of face larger than the width of face of the 1st edge by the side of a record gap as a configuration which the up magnetic pole looked at from ABS, the width of face of the entrance side of magnetic flux will become large, and the width of face of an outlet side will become narrow, and an over-writing property improves sharply. And since it has width of face equal to predetermined distance detached building ****** at least from the 1st edge by the side of a record gap, un-arranging [for which the effective width of recording track of the magnetic head spreads] is lost.
[0011] As for the width of face of an up magnetic pole, it is desirable to change almost continuously from predetermined distance detached building ****** to the 2nd edge.
[0012] As a configuration seen from ABS, the edge by the side of the record gap of a lower magnetic pole has projected to convex in the part which counters an up magnetic pole, and it is also desirable that this lobe has width of face equal to the width of face of the 1st edge.
[0013] It is also desirable that the edge by the side of the record gap of a lower magnetic pole is evenly formed as a seen configuration including the part which counters an up magnetic pole from ABS.
[0014] It is desirable that predetermined distance is 1 micrometer.
[0015] It is also desirable that laminating formation of the reproducing-head section equipped with the magneto-resistive effect (MR) component is carried out in one with the recording head section.
[0016] After carrying out the laminating of the layer further for lower magnetic poles according to this invention, the laminating of the layer for record gaps is carried out. It is the manufacture approach of the thin film magnetic head which forms an up magnetic pole while forming a coil on the layer for these record gaps. The manufacture approach of the thin film magnetic head formed in the configuration which has width of face equal to predetermined distance detached building ****** at least for an up magnetic pole from the 1st edge by the side of a record gap, and has width of face with the 2nd edge of the opposite side of a record gap larger than the width of face of the 1st edge is offered.
[0017] It is desirable to form an up magnetic pole so that the width of face may change almost continuously from predetermined distance detached building ****** to the 2nd edge.
[0018] It is desirable to set predetermined distance to 1 micrometer.
[0019] It is also desirable to control and form the exposure conditions of a resist [in / for the configuration of an up magnetic pole / the frame galvanizing method]. The exposure condition may be the focal location of exposure, or the numerical aperture

of exposure optical system.
[0020] It is also desirable to carry out dry etching of the layer for lower magnetic poles by using an up magnetic pole as a mask so that the edge by the side of the record gap of a lower magnetic pole may have projected to convex in the part which counters an up magnetic pole and may serve as a configuration in which this lobe has width of face equal to the width of face of the 1st edge.
[0021] It is also desirable to form MR component, after carrying out the laminating of the layer for the 1st shielding and carrying out the laminating of the layer for MR components through the layer for shielding gaps on the layer for the 1st shielding on a substrate front face, and to, carry out the laminating of the layer for lower magnetic poles through the layer for shielding gaps subsequently to MR component top.
[0022]
[Embodiment of the Invention] Drawing 3 is drawing showing roughly the configuration seen from the ABS side about the inductive recording head section in 1 operation gestalt of this invention.
[0023] In this drawing, in 30, a lower magnetic pole and 31 show a record gap, and, as for an up magnetic pole and 30a, 32 shows the convex lobe of the lower magnetic pole 30, respectively. The lower limit of the up magnetic pole 32 has countered the upper limit of lobe 30a of the lower magnetic pole 30 through the record gap 31. Lobe 30a is width-of-face WP2A. It has and the up magnetic pole 32 is also the predetermined distance LS from that lower limit. It is this width-of-face WP2A to a location 33. It has equal width of face. The width of face of the up magnetic pole 32 becomes large the shape of a curve gradually from this location 33, and is width-of-face WP2B at that upper limit. It has become. As a mere example, each numeric value is as follows. WP2A =0.9micrometer, WP2B =1.5micrometer, LG =0.3micrometer, LT =0.5micrometer. However, LG Record gap length and LT It is the die length of lobe 30a. Predetermined distance LS (the following etc. is called width-of-face partial die length) It is set as LS >=1.0micrometer so that it may mention later.
[0024] An up magnetic pole is the lower limit of an up magnetic pole to the predetermined distance LS, as were shown in drawing 3 and the width of face shows drawing 4 other than the configuration which becomes large the shape of a curve gradually from a location 33. You may be the configuration which becomes large linearly gradually from a location 43. In drawing 4 , in 40, as for an up magnetic pole and 40a, a lower magnetic pole and 41 show a record gap, 42 shows the lobe of the lower magnetic pole 40, respectively, and the lower limit of the up magnetic pole 42 has countered the upper limit of lobe 40a of the lower magnetic pole 40 through the record gap 41. Lobe 40a is width-of-face WP2A. It has and the up magnetic pole 42 is also the predetermined distance LS from that lower limit. It has width of face equal to this width-of-face WP2A to a location 43. The width of face of the up magnetic pole 42 becomes large the shape of a straight line gradually from this location 43, and is width-of-face WP2B at that upper limit. It has become.
[0025] Drawing 5 is process drawing explaining the manufacture approach of the thin film magnetic head in the operation gestalt of drawing 3 , and shows the sectional view seen the sectional view by the flat surface passing through the core of the truck of the magnetic head, and from ABS, respectively. In addition, this operation gestalt is the case of the compound-die thin film magnetic head by which laminating formation of the inductive recording head section and the MR reproducing-head section is carried out in one. However, it cannot be overemphasized that this invention can apply also about the thin film magnetic head in which only the inductive recording head section is prepared.
[0026] First, the laminating of the insulating layer 50 is carried out on the substrate by ceramic ingredients, such as AlTiC, which is not illustrated. this insulating layer 50 — aluminum 2O3 and SiO2 etc. — an insulating material is preferably formed in about 1000-20000nm thickness by a spatter etc.
[0027] Subsequently, on it, the laminating of the layer for lower shielding 51 is carried out, and the laminating of the insulating layer 52 for shielding gaps is further carried out on it. The layer for lower shielding 51 forms preferably ingredients, such as FeAiSi, NiFe, CoFe, CoFeNi, FeN, FeZrN, FeTaN, CoZrNb, and CoZrTa, in about 100-5000nm thickness by the spatter or the galvanizing method. the insulating layer 52 for shielding gaps — aluminum 2O3 and SiO2 etc. — an insulating material is preferably formed in about 10-200nm thickness by a spatter etc.
[0028] subsequently, the MR component 53 on an insulating layer 52 is formed, and it connects with the both ends of this MR component 53 electrically — as — a lead — a conductor 54 is formed. Although the MR component 53 is good also as monolayer structure of the magnetic substance, it is desirable to consider as the multilayer structure which carried out the laminating of a magnetic layer and the non-magnetic layer by turns. As an ingredient of a magnetic layer, NiFe, NiFeRh, FeMn, NiMn, Co, Fe and NiO, NiFeCr, etc. are desirable, and Ta, Cu, Ag, etc. are desirable as an ingredient of a non-magnetic layer. Moreover, it is good also as structure which carried out the laminating of the multi-unit as multilayer structure by making two or more layer structures, such as 3 layer structures of NiFeRh/Ta/NiFe, NiFe/Cu/NiFe/FeMn, NiFe/Cu/Co/FeMn, Cu/Co/Cu/NiFe, Fe/Cr, Co/Cu, and Co/Ag, into one unit. In the case of multilayer structure, as for especially the thickness of a magnetic layer, it is desirable to set 0.5-50nm to 1-25nm, and, also as for the thickness of a non-magnetic layer, it is desirable to be especially referred to as 1-25nm 0.5-50nm. Especially the number of repeat laminatings of an above-mentioned unit has 1 - 20 desirable times 1 to 30 times. As for especially the thickness as the MR component 53 whole, it is desirable that it is 10-60nm 5-100nm. In order to carry out the laminating of the layer for MR components, a spatter, the galvanizing method, etc. are used. a lead — as for especially the conductor 54, it is desirable to form 10-500nm of conductive ingredients, such as W, Cu, Au, Ag, Ta, Mo, and CoPt, in about 50-300nm thickness by the spatter, the galvanizing method, etc.
[0029] subsequently, the MR component 53 and a lead — the laminating of the insulating layer 55 for shielding gaps is carried out on a conductor 54. this insulating layer 55 — aluminum 2O3 and SiO2 etc. — it is a spatter etc. and 5-500nm of insulating materials is preferably formed in about 10-200nm thickness.
[0030] Patterning of each class of MR reproducing-head section described above is carried out by the approach which used together the general lift-off method, the milling method, or these which used the resist pattern.
[0031] Subsequently, the laminating of the magnetic layer for lower magnetic pole 56 of the recording head section which makes up shielding of the MR component 53 serve a double purpose is carried out, and the laminating of the insulating layer for record gap 57 is carried out on it. The layer for lower magnetic pole 56 forms preferably soft magnetic materials, such as NiFe, CoFe, CoFeNi, and FeN, in about 500-4000nm thickness by the galvanizing method, a spatter, etc. the insulating layer for record gap 57 — aluminum 2O3 and SiO2 etc. — it is a spatter etc. and an ingredient is formed in about 10-500nm thickness.
[0032] Then, the insulating layer 59 which encloses a coil 58 and this coil 58 is formed on the record gap 57. A coil 58 is the frame galvanizing method etc. and forms conductive ingredients, such as Cu, in the thickness of about 2000-5000nm. An insulating layer 59 carries out heat curing of the photoresist ingredient, and is formed in about 3000-20000nm thickness.
[0033] The layer structure pass the above process is shown in drawing 5 (A). In addition, a coil 58 may be two-layer at the

business shown in this drawing, and may be three or more layers, or may be a monolayer.
[0034] Subsequently, as shown in drawing 5 (B), the up magnetic pole 60 which has the magnetic pole section by the side of ABS and the York section on the backside is formed by the frame galvanizing method on the insulating layer 59 formed in this way. The up magnetic pole 60 forms preferably soft magnetic materials, such as NiFe, CoFe, CoFeNi, and FeN, in about 3000-5000nm thickness. Under the present circumstances, the configuration seen from the ABS side of the magnetic pole section of the up magnetic pole 60 is formed so that it may become like drawing 3 or drawing 4 .
[0035] Hereafter, the frame galvanizing method for forming the up magnetic pole 60 of such a configuration is explained. Drawing 6 is process drawing which explains the formation process of the up magnetic pole by the frame galvanizing method in this operation gestalt in detail.
[0036] As shown at drawing 6 (B) on the record gap 57 shown in drawing 6 (A), the low resistance film 61 by the same component as layers which should be galvanized preferably, such as Cu, NiFe, and Au, is formed by about 10-500nm thickness.
[0037] Subsequently, as shown in drawing 6 (C), a resist 62 is applied on the low resistance film 61. Under the present circumstances, it is made for the thickness of a resist 62 to become thicker than the thickness of a plating layer. Subsequently, as shown in drawing 6 (D), a mask pattern is exposed, and negatives are imprinted and developed to this resist 62. The exposure conditions of the resist 62 about this mask pattern were suitably controlled by this operation gestalt, and drawing 3 or the configuration like drawing 4 has been acquired. Drawing 7 is drawing showing that the pattern configuration of a resist 62 is controlled by changing the focal location of exposure as the exposure condition.
[0038] In drawing 7 , the numeric value of an axis of ordinate shows the height [mum] of a resist, and the shadow area shows the resist part which remains after development. Moreover, when drawing 7 (A) makes a focal location a location with a height of 5.0 micrometers from a substrate front face, When drawing 7 (B) makes a focal location a location with a height of 4.0 micrometers and drawing 7 (C) makes a focal location a location with a height of 3.0 micrometers, Drawing 7 (D) shows the case where drawing 7 (F) makes a focal location a location with a height of 0.0 micrometers, respectively, when a focal location is made into a location with a height of 2.0 micrometers, and drawing 7 (E) makes a focal location a location with a height of 1.0 micrometers.
[0039] It becomes possible by controlling the focal location of exposure of the resist 62 about a mask pattern to acquire a desired resist configuration so that clearly also from drawing 7 . In addition, although the above explained the example which controls the focal location of exposure as exposure conditions, even if it controls the numerical aperture of exposure optical system, it is possible to acquire the same effectiveness.
[0040] Subsequently, as shown in drawing 6 (E), soft magnetic materials, such as NiFe, CoFe, CoFeNi, and FeN, are galvanized using resist 62' by which patterning was carried out in this way, and the up magnetic pole 60 is obtained. Then, as shown in drawing 6 (F), resist 62' is exfoliated using an organic solvent etc.
[0041] In addition, the up magnetic pole 60 can also be formed instead of the frame galvanizing method by the dry process which combined the spatter and the milling method.
[0042] Subsequently, as shown in drawing 5 (C), dry etching, such as ion milling and RIE (reactive ion etching), is performed by using as a mask the up magnetic pole 60 which carried out in this way and was formed, the part which is not covered with the above-mentioned low resistance film 61 and the mask of the insulating layer for record gap 57 is removed, and the part which is not covered with a mask to the middle of the magnetic layer further for lower magnetic pole 56 is removed.
[0043] Thereby, as shown in drawing 5 (D), lobe 56a which counters the lower limit of the up magnetic pole 60 through the record gap 57, and has the same width of face is formed in the lower magnetic pole 56. Subsequently, after forming a pad bump etc., the laminating of the protective layer 63 is carried out. this protective layer 63 — aluminum 2O3 and SiO2 etc. — it is a spatter etc. and 5-500nm of insulating materials is preferably formed in about 5000-50000nm thickness.
[0044] according to [as explained in relation to drawing 3] this operation gestalt — the up magnetic pole 32 (60) — from that lower limit — etc. — width-of-face partial die-length LS only — width-of-face WP2A having — **** — the width of face of this up magnetic pole 32 (60) — the method of that Gokami — going — gradually — the shape of a curve — large — becoming — that upper limit — this width-of-face WP2A Large width-of-face WP2B It has become. This **** partial die-length LS If it is set as LS >=1.0micrometer, the effective width of recording track of a head will not spread. Drawing 8 is this **** partial die-length LS of an up magnetic pole. It is the property Fig. showing relation with the effective width of recording track. This is a property at the time of setting an up magnetic pole and a lower magnetic pole dimension to WP2A =0.9micrometer, WP2B =1.5micrometer, LG =0.3micrometer, and LT =0.5micrometer. Moreover, drawing 9 is the property Fig. showing the relation between the width of recording track and an over-writing property.
[0045] clear from drawing 8 — like — etc. — width-of-face partial die-length LS although the effective width of recording track is maintained by 1.0 micrometers when it is 1.0 micrometers or more — **** partial die-length LS If it becomes shorter than this, the effective width of recording track will spread rapidly.
[0046] Since the width of face of the upper limit of an up magnetic pole has spread, the magnetic head of this operation gestalt can maintain a good over-writing property, also when the width of recording track becomes small, but if the width of recording track becomes [the conventional up magnetic pole] small by the magnetic head of width of face, such as all, an over-writing property will get worse sharply, so that drawing 9 may show.
[0047] therefore — according to this operation gestalt — width-of-face WP2B of the upper limit of an up magnetic pole Width-of-face WP2A of the lower limit while enlarging — etc. — width-of-face partial die-length LS By being referred to as 1.0 micrometers or more, both improvement in the formation of the ** width of recording track and an over-writing property can be attained to coincidence.
[0048] Drawing 10 is process drawing explaining the manufacture approach of the thin film magnetic head in other operation gestalten of this invention, and shows the sectional view seen the sectional view by the flat surface passing through the core of the truck of the magnetic head, and from ABS, respectively. This operation gestalt is also the case of the compound-die thin film magnetic head by which laminating formation of the inductive recording head section and the MR reproducing-head section is carried out in one.
[0049] Although the lower magnetic pole has convex lobe 30a with the lower limit of an up magnetic pole with the operation gestalt of drawing 3 into the part to counter, the upper limit of a lower magnetic pole serves as a flat configuration with this operation gestalt.
[0050] this operation gestalt — setting — the insulating layer 50 on a substrate, the lower shielding 51, the insulating layer 52 for shielding gaps, the MR component 53, and a lead — the production process until it forms the insulating layer 59 which encloses a conductor 54, the insulating layer 55 for shielding gaps, the magnetic layer for lower magnetic pole 100, the insulating layer for record gap 57, a coil 58, and this coil 58 is completely the same as that of what was stated to drawing 5 . The layer structure of

this condition is shown in drawing 10 (A).
[0051] Subsequently, as shown in drawing 10 (B), the up magnetic pole 60 which has the magnetic pole section by the side of ABS and the York section on the backside is formed by the frame galvanizing method on the insulating layer 59 formed in this way. Besides, it is completely the same as that of what also stated formation of the section magnetic pole 60 to drawing 5 .
[0052] With this operation gestalt, without performing milling to the lower magnetic pole 100 after that, as shown in drawing 10 (C), a pad bump etc. is formed and the laminating of the protective layer 63 is carried out. Therefore, with this operation gestalt, the upper limit of the lower magnetic pole 100 performs the almost same process as the case of the operation gestalt of drawing 3 except for becoming a flat configuration.
[0053] The other configurations in this operation gestalt, the operation effectiveness, a modification mode, etc. are the same as that of the case of the operation gestalt of drawing 3 almost.
[0054] Drawing 11 is process drawing explaining the manufacture approach of the thin film magnetic head in the operation gestalt of further others of this invention, and shows the sectional view seen the sectional view by the flat surface passing through the core of the truck of the magnetic head, and from ABS, respectively. This operation gestalt is also the case of the compound-die thin film magnetic head by which laminating formation of the inductive recording head section and the MR reproducing-head section is carried out in one.
[0055] Although the magnetic pole section and the York section of an up magnetic pole are formed in coincidence at the same frame plating process in the operation gestalt of drawing 3 , the magnetic pole section and the York section are formed at a separate process in this operation gestalt.
[0056] this operation gestalt — setting — the insulating layer 50 on a substrate, the lower shielding 51, the insulating layer 52 for shielding gaps, the MR component 53, and a lead — the production process until it forms a conductor 54, the insulating layer 55 for shielding gaps, the magnetic layer for lower magnetic pole 56, and the insulating layer for record gap 57 is completely the same as that of what was stated to drawing 5 . The layer structure of this condition is shown in drawing 11 (A).
[0057] Subsequently, as shown in drawing 11 (B), the insulating layer 110 for deciding throat height is formed on the insulating layer for record gap 57. However, it is not necessary to necessarily form this insulating layer 110.
[0058] Subsequently, as shown in drawing 11 (C), magnetic pole section 111a of an up magnetic pole and York back end section 111b are formed by the frame galvanizing method. It is completely the same as that of what also stated this process to drawing 5 except for the point which forms only magnetic pole section 111a of an up magnetic pole, and York back end section 111b.
[0059] Then, as shown in drawing 11 (D), dry etching, such as ion milling and RIE (reactive ion etching), is performed by using as a mask magnetic pole section 111a of the up magnetic pole which carried out in this way and was formed, the part which is not covered with the low resistance film used at the frame plating process and the mask of the insulating layer for record gap 57 is removed, and the part which is not covered with a mask to the middle of the magnetic layer further for lower magnetic pole 56 is removed.
[0060] Thereby, as shown in drawing 11 (E), lobe 56a which counters the lower limit of magnetic pole section 111a of an up magnetic pole through the record gap 57, and has the same width of face is formed in the lower magnetic pole 56. subsequently, aluminum 2O3 etc. — with an ingredient, the nonmagnetic insulating layer 112 for flattening is formed, and flattening is ground and carried out until magnetic pole section 111a of an up magnetic pole and York back end section 111b become predetermined height.
[0061] Subsequently, as shown in drawing 11 (F), the insulating layer 114 which encloses a coil 113 and this coil 113 is formed like the case of drawing 5 on an insulating layer 112, and the York section 115 of an up magnetic pole is further formed on it. It unites with magnetic pole section 111a of an up magnetic pole and York back end section 111b which were formed previously, and, finally this York section 115 serves as an up magnetic pole.
[0062] The front end (ABS side edge) of the York section 115 is formed so that it may be shown and may connect [drawing 11 / (F)] as auxiliary magnetic pole section 115a on magnetic pole section 111a, and the width of face is formed more than the width of face of the upper limit of magnetic pole section 111a. It is more desirable for auxiliary magnetic pole section 115a not to form the front end (ABS side) to an ABS side edge. When forming to an ABS side edge, it is also desirable to form the configuration seen from the ABS side of auxiliary magnetic pole section 115a so that the width of face may spread continuously from the width of face of the upper limit of magnetic pole section 111a.
[0063] Subsequently, as shown in drawing 11 (G), a pad bump etc. is formed and the laminating of the protective layer 116 is carried out.
[0064] The other configurations in this operation gestalt, the operation effectiveness, a modification mode, etc. are the same as that of the case of the operation gestalt of drawing 3 almost.
[0065] Drawing 12 is process drawing explaining the manufacture approach of the thin film magnetic head in this invention and also other operation gestalten, and shows the sectional view seen the sectional view by the flat surface passing through the core of the truck of the magnetic head, and from ABS, respectively. This operation gestalt is also the case of the compound-die thin film magnetic head by which laminating formation of the inductive recording head section and the MR reproducing-head section is carried out in one.
[0066] Although the lower magnetic pole has convex lobe 56a with the lower limit of an up magnetic pole with the operation gestalt of drawing 11 into the part to counter, the upper limit of a lower magnetic pole serves as a flat configuration with this operation gestalt.
[0067] this operation gestalt — setting — the insulating layer 50 on a substrate, the lower shielding 51, the insulating layer 52 for shielding gaps, the MR component 53, and a lead — the production process until it forms magnetic pole section 111a and York back end section 111b of a conductor 54, the insulating layer 55 for shielding gaps, the magnetic layer for lower magnetic pole 120, the insulating layer for record gap 57, and an up magnetic pole is completely the same as that of what was stated to drawing 11 . The layer structure of this condition is shown in drawing 12 (C).
[0068] With this operation gestalt, without performing milling to the lower magnetic pole 120 after that, flattening is ground and carried out until it forms the nonmagnetic insulating layer 112 for flattening and magnetic pole section 111a of an up magnetic pole and York back end section 111b become predetermined height, as shown in drawing 12 (D).
[0069] Henceforth, according to drawing 11 (F) and the same process as (G), the insulating layer 114 which encloses a coil 113 and this coil 113 is formed, further, the York section 115 of an up magnetic pole is formed on it, a pad bump etc. is formed after that, and the laminating of the protective layer 116 is carried out. This process is shown in drawing 12 (E) and (F). That is, with this operation gestalt, the upper limit of the lower magnetic pole 120 performs the almost same process as the case of the operation gestalt of drawing 11 except for becoming a flat configuration.

[0070] The other configurations in this operation gestalt, the operation effectiveness, a modification mode, etc. are the same as that of the case of the operation gestalt of drawing 3 almost.
[0071] This invention cannot be shown in instantiation, and not all the operation gestalten described above can show it restrictively, and can carry out this invention in other various deformation modes and modification modes. Therefore, the range of this invention is specified by only a claim and its equal range.
[0072]
[Effect of the Invention] Since the 2nd edge of the opposite side of a record gap serves as a configuration which has width of face larger than the width of face of the 1st edge by the side of a record gap as a configuration which the up magnetic pole looked at from ABS according to this invention as explained to the detail above, the width of face of the entrance side of magnetic flux will become large, and the width of face of an outlet side will become narrow, and an over-writing property improves sharply. And since it has width of face equal to predetermined distance detached building ****** at least from the 1st edge by the side of a record gap, un-arranging [for which the effective width of recording track of the magnetic head spreads] is lost.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

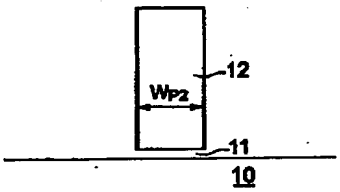
[Brief Description of the Drawings]
[Drawing 1] It is drawing showing roughly the configuration seen from the ABS side about the conventional general inductive recording head section.
[Drawing 2] It is drawing showing roughly the configuration seen from the ABS side about other conventional inductive recording head sections.
[Drawing 3] It is drawing showing roughly the configuration seen from the ABS side about the inductive recording head section in 1 operation gestalt of this invention.
[Drawing 4] It is drawing showing roughly the configuration seen from the ABS side about the inductive recording head section in the modification mode of the operation gestalt of drawing 3 .
[Drawing 5] It is process drawing explaining the manufacture approach of the thin film magnetic head in the operation gestalt of drawing 3 .
[Drawing 6] It is process drawing which explains the formation process of the up magnetic pole by the frame galvanizing method in the operation gestalt of drawing 3 in detail.
[Drawing 7] By changing the focal location of exposure, it is drawing showing that the pattern configuration of a resist is controlled.
[Drawing 8] Width-of-face partial die-length LS, such as an up magnetic pole It is the property Fig. showing relation with the effective width of recording track.
[Drawing 9] It is the property Fig. showing the relation of the width of recording track and the over-writing property in the operation gestalt of drawing 3 .
[Drawing 10] It is process drawing explaining the manufacture approach of the thin film magnetic head in other operation gestalten of this invention.
[Drawing 11] It is process drawing explaining the manufacture approach of the thin film magnetic head in the operation gestalt of further others of this invention.
[Drawing 12] It is process drawing explaining the manufacture approach of the thin film magnetic head in this invention and also other operation gestalten.
[Description of Notations]
30, 40, 56,100,120 Lower magnetic pole
30a, 40a, 56a Lobe
31, 41, 57 Record gap
32, 42, 60 Up magnetic pole
50 59,110,112,114 Insulating layer
51 Lower Shielding
52 55 Insulating layer for shielding gaps
53 MR Component
54 Lead — Conductor
58,113 Coil
61 Low Resistance Film
62 Resist
63,116 Protective layer
111a Magnetic pole section
111b York back end section
115 York Section
115a Auxiliary magnetic pole section

[Translation done.]

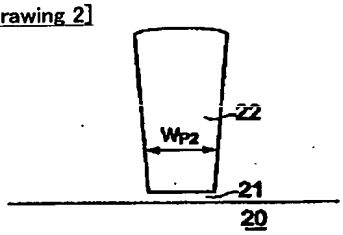
* NOTICES *

DRAWINGS

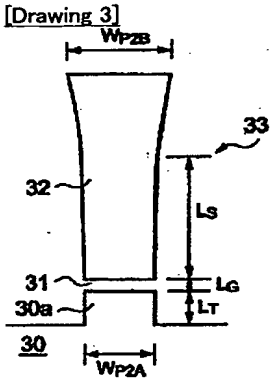
[Drawing 1]



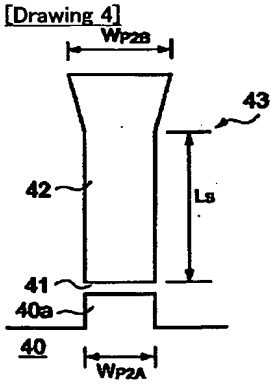
[Drawing 2]



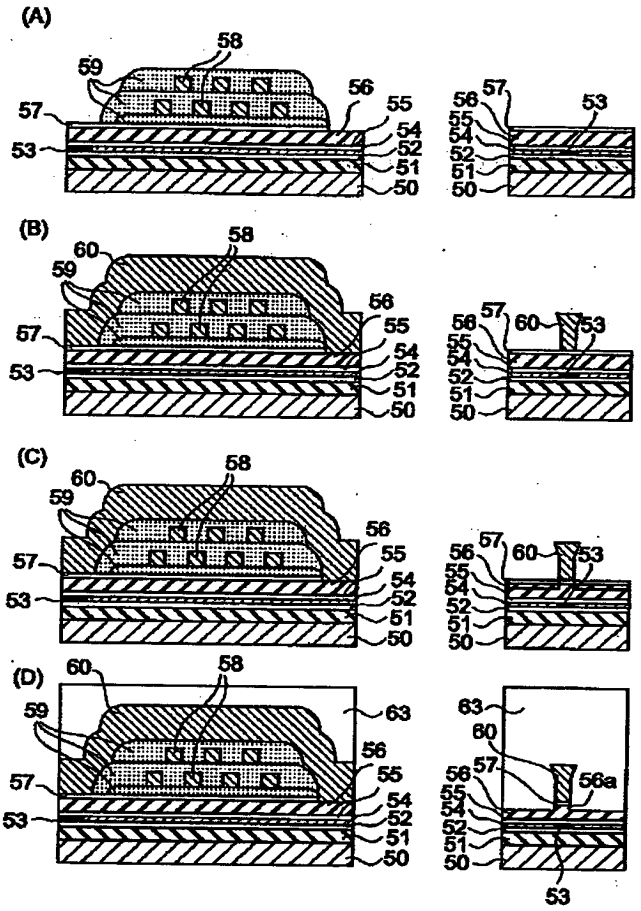
[Drawing 3]



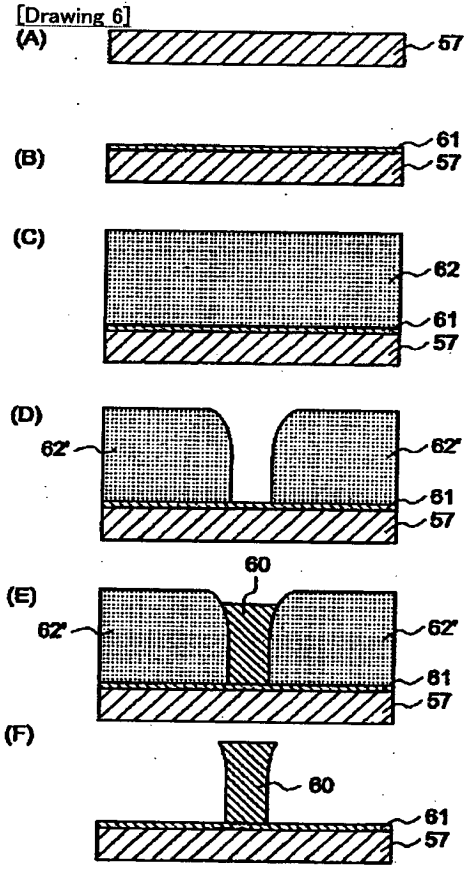
[Drawing 4]



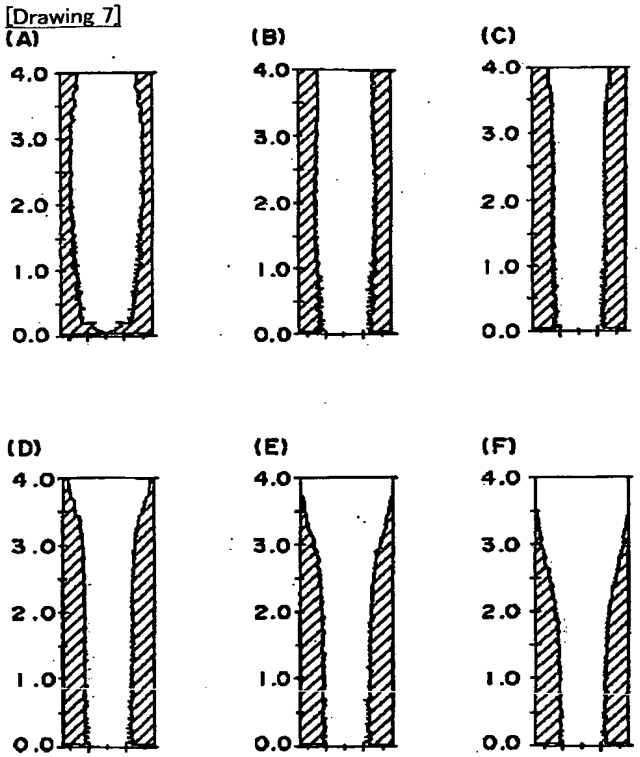
[Drawing 5]



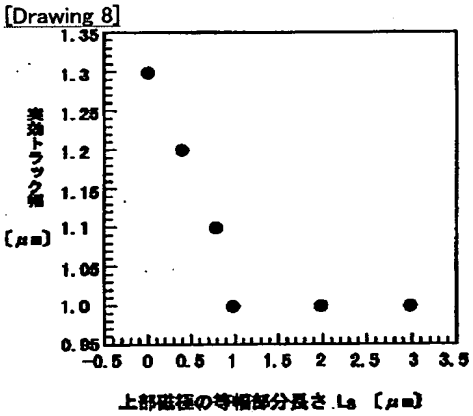
[Drawing 6]



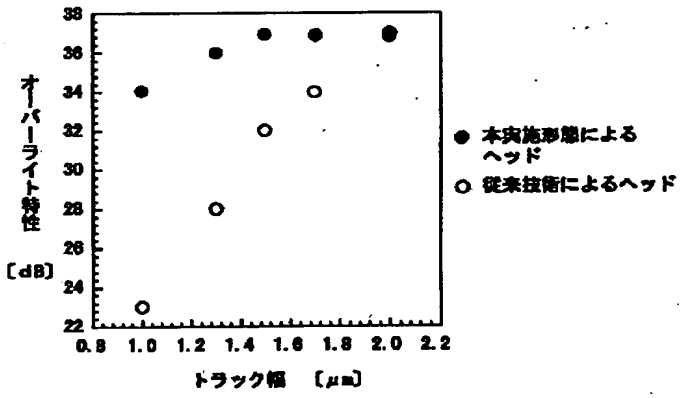
[Drawing 7]



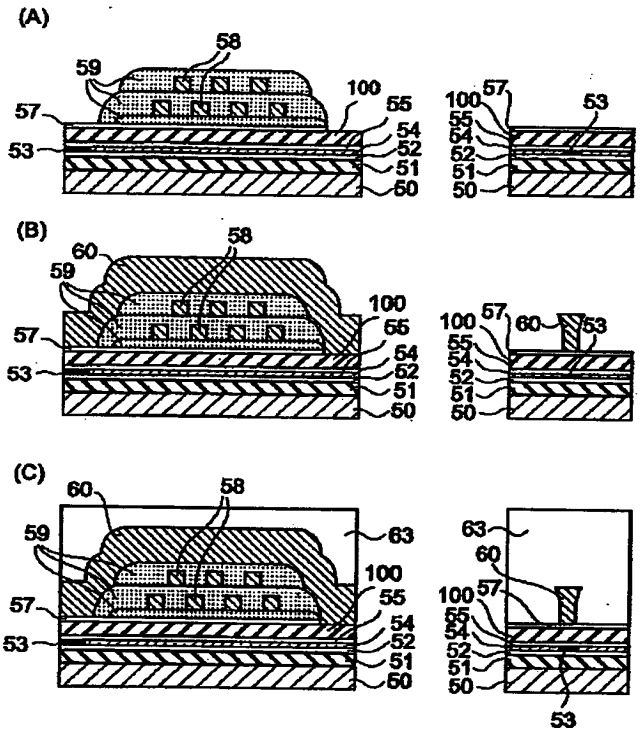
[Drawing 8]



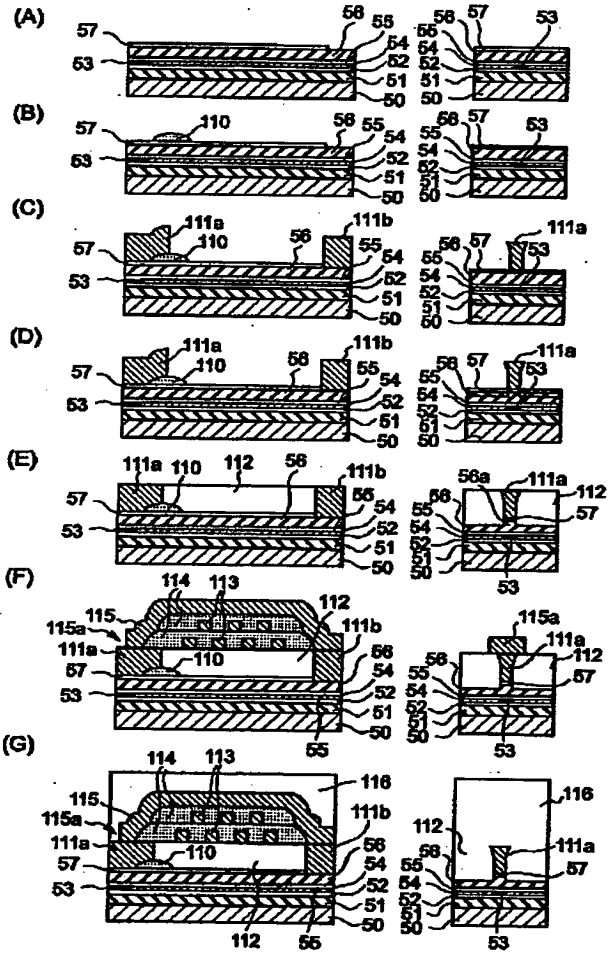
[Drawing 9]



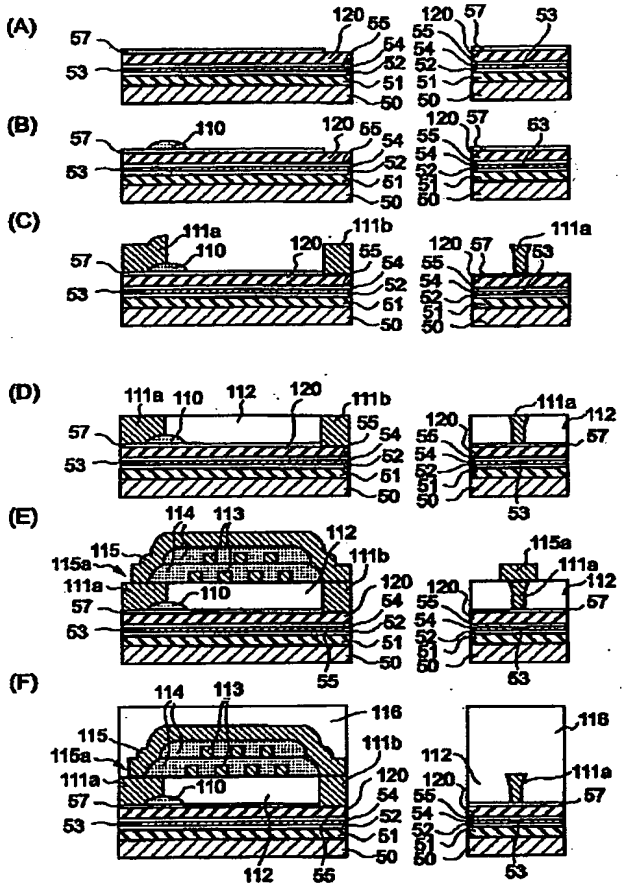
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]